December 20, 1950

Deep Rock Oil Corporation
Atlas Life Building
Tulsa, Oklahoma

Attention: Mr. T. F. Lawry

Gentlemen:

Enclosed herewith is the report of the analysis made on the 2¼" rotary core taken from the Engel Lease, Well No. I-11, Crawford County, Kansas, and submitted to our laboratory on November 25, 1950.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:mm

c.c. to Mr. Neil Henderson
Mr. Jack West

DEEP ROCK OIL CORPORATION

CORE ANALYSIS REPORT

ENGEL LEASE **WELL NO. I-11**

CRAWFORD COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

DECEMBER 20, 1950

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company: Deep Rock Oil Corporation Lease: Engel Well No.: I-11

Location: NE¼

Section: 28 Twp.: 28S Rge.: 22E County: Crawford State: Kansas

Name of Sand	Bartlesville
Top of Core	379.40
Bottom of Core	398.30
Top of Pay Sand	384.00
Bottom of Oil Sand	396.75
Total Feet of Permeable Sand	13.80

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	2.15	2.15
10 - 20	2.90	5.05
20 - 30	4.10	9.15
30 - 40	1.40	10.55
40 & above	3.25	13.80

Average Permeability, Millidarcys	27.11
Average Percent Porosity	18.20
Average Percent Oil Saturation	40.16
Average Percent Water Saturation	34.63
Average Oil Content, Bbls./A. Ft.	564.
Total Oil Content, Bbls./Acre	8,282.
Average Percent Oil Recovery by Laboratory Flooding Tests	11.87
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	175.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,518.
Total Calculated Oil Recovery, Bbls./Acre	3,600.
Packer Setting, Feet	389.00
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	

The above averages are for that part of the cored section extending from the packer setting to the bottom of the core.

Fresh water was used as a circulating fluid in the coring of the sand in this well. It is understood that this well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
379.48 - 379.62	Laminated sandstone and shale.
379.62 - 380.17	Light brown fine grained micaceous sandstone.
380.17 - 380.30	Laminated sandstone and shale.
380.30 - 384.00	Light brown fine grained slightly shaley sandstone.
384.00 - 387.30	Brown fine grained micaceous sandstone containing a shale break.
387.30 - 387.65	Finely laminated sandy shale.
387.65 - 387.75	Laminated shaley sandstone.
387.75 - 390.90	Brown fine grained micaceous sandstone containing a shale break.
390.90 - 391.40	Brown fine grained slightly laminated micaceous shaley sandstone.
391.40 - 394.05	Dark brown fine grained micaceous sandstone.
394.05 - 394.30	Brown fine grained slightly laminated micaceous shaley sandstone.
394.30 - 395.35	Brown fine grained micaceous sandstone.
395.35 - 395.60	Brown fine grained laminated micaceous shaley sandstone.
395.60 - 396.75	Dark brown fine grained micaceous sandstone.
396.75 - 398.30	Dark fine grained micaceous carbonaceous sandstone.

Coring was started at a depth of 379.48 feet in laminated sandstone and shale and completed at 398.30 feet in dark fine grained micaceous carbonaceous sandstone. This core shows a total of 17.95 feet of sandstone. For the most part the sand body is made up of fine grained micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections are 17.36, 39.47 and 9.83 millidarcys respectively; while that of the pay sand, or that part of the cored section extending from the packer setting to the bottom of the core, is 27.11 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand has a fairly irregular permeability profile.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core shows a good weighted average percent oil saturation, namely, 40.16. The weighted average percent oil saturation of the upper, middle and lower sections are 31.64, 41.09 and 42.33 respectively. The weighted average percent water saturation of the upper, middle and lower sections are 42.38, 31.18 and 37.91 respectively; while that of the pay sand is 34.63 (See Table IV). This gives an overall weighted average total fluid saturation (for the pay sand) of 74.79 percent. This comparatively low total fluid saturation indicates that an appreciable amount of fluid was lost during coring which was probably oil.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VII and VIII. From the results given in these tables and on the coregraph, it is evident that very little flushing of the sand occurred during coring as the sand section has a fairly uniform chloride content. This would indicate that most of the oil lost during coring was due to the expansion of gas carried in solution by the oil.

The weighted average oil content of the upper, middle and lower sections are 419, 573 and 596 barrels per acre foot respectively; while that of the pay sand is 564. The total oil content, as shown by this core, is 9,220 barrels per acre, of which 8,282 barrels are in the pay sand section(See Table IV).

LABORATORY FLOODING TESTS

The pay sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 1,518 barrels of oil per acre was obtained from 8.65 feet of sand. The weighted average percent oil saturation was reduced from 40.37 to 28.50, or represents an average recovery of 11.87 percent. The weighted average effective permeability of the samples is 0.774 millidarcys, while the average initial fluid production pressure is 24.3 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 13 samples tested, 10 produced water and 9 oil. This indicates that only part of the sand represented by these samples is floodable. The tests also show that the sand has a low effective permeability for its depth.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 3,600 barrels of oil per acre, or an average of 379 barrels per acre foot provided the sand will take water satisfactorily. In calculating this recovery, an allowance was made for oil lost during coring.

Like the other cores taken on this lease and analyzed by us, the principle drawback of the pay sand is the fact that it is comparatively tight for its depth. In other words, some difficulty may be encountered in getting the sand to take water under the common practice method. This core shows a total of 9.50 feet of floodable sand.

Oil Field Research Laboratories

SHOT RECOMMENDATION

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
387.0 - 396.0	9.0	4.5	3.1	27.9

Recommended Packer Setting 383.0 feet

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	379.65	19.	0.28	0.28	5.32
2	380.10	6.4	0.27	0.55	1.73
3	381.53	16.	0.70	1.25	11.20
4	381.95	18.	0.45	1.70	8.10
5	382.34	10.	0.50	2.20	5.00
6	382.95	14.	0.65	2.85	9.10
7	383.60	10.	0.40	3.25	4.00
8	383.80	6.1	0.30	3.55	1.83
9	384.42	26.	0.65	4.20	16.90
10	384.88	21.	0.35	4.55	7.35
11	385.15	30.	0.25	4.80	7.50
12	385.40	24.	0.80	5.60	19.20
13	386.10	7.2	0.10	5.70	0.72
14	386.35	39.	0.30	6.00	11.70
15	386.50	52.	0.35	6.35	18.20
16	387.13	26.	0.50	6.85	13.00
17	387.80	29.	0.15	7.00	4.35
18	388.00	49.	0.75	7.75	36.75
19	388.75	18.	0.20	7.95	3.60
20	389.03	54.	0.25	8.20	13.50
21	389.25	26.	0.50	8.70	13.00
22	390.00	26.	0.60	9.30	15.60
23	390.50	32.	0.45	9.75	14.40
24	390.85	28.	0.20	9.95	5.60
25	391.55	62.	0.35	10.30	21.70
26	391.95	27.	0.35	10.65	9.45
27	392.30	60.	0.50	11.15	30.00
28	392.90	45.	0.50	11.65	22.50
29	393.35	34.	0.40	12.05	13.60
30	393.70	52.	0.55	12.60	28.60
31	394.35	5.4	0.20	12.80	1.08
32	394.70	11.	0.35	13.15	3.85
33	395.00	17.	0.50	13.65	8.50
34	395.75	19.	0.30	13.95	5.70
35	396.05	15.	0.30	14.25	4.50
36	396.40	13.	0.55	14.80	7.15
37	397.05	3.7	0.50	15.30	1.85
38	397.30	3.9	0.40	15.70	1.56
39	397.80	3.4	0.35	16.05	1.19
40	398.15	4.9	0.30	16.35	1.47

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
379.62 - 386.05	5.60	17.36	97.23
386.05 - 394.05	7.00	39.47	276.27
394.30 - 398.30	3.75	9.83	36.85
383.00 - 398.30	13.80	27.11	374.10

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RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content, Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1	380.44	17.9	25.7	41.9	67.6	357	0.60	0.60	214
2	381.00	16.0	27.7	45.0	72.7	344	1.10	1.70	378
3	383.12	15.4	29.8	44.9	74.7	356	2.00	3.70	712
4	384.50	18.8	36.2	38.7	74.9	528	1.00	4.70	528
5	385.62	18.4	38.4	38.5	76.9	548	1.05	5.75	575
6	386.75	19.6	40.1	34.2	74.3	610	1.15	6.90	703
7	388.23	19.6	39.7	28.2	67.9	603	0.90	7.80	543
8	389.52	19.1	42.7	26.3	69.0	633	2.20	10.00	1,393
9	391.04	17.2	34.2	43.3	77.5	456	0.50	10.50	228
10	392.50	18.9	42.5	33.4	75.9	623	1.80	12.30	1,121
11	393.93	18.3	40.9	30.9	71.8	580	0.85	13.15	493
F-11	394.18	16.8	32.5	-	-	423	0.25	13.40	106
12	395.23	16.8	36.2	41.5	77.7	471	1.05	14.45	495
F-12	395.47	14.9	33.7	-	-	390	0.25	14.70	98
13	396.63	17.3	45.4	34.6	80.0	609	1.15	15.85	700
F-13	396.88	18.2	51.8	-	-	731	1.55	17.40	1,133
							Total	- - - -	9,220

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SUMMARY OF SATURATION TESTS

TABLE IV

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
380.30 - 386.05	5.75	16.91	31.64	42.35	419	2,407
386.15 - 394.05	7.40	18.97	41.09	31.18	578	4,281
394.30 - 398.30	4.25	17.32	42.33	37.91	596	2,532
383.00 - 398.30	14.70	18.20	40.16	34.63	564	8,282

Oil Field Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company: Deep Rock Oil Corporation Lease: Engel Well No. I-11

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	380.75	18.1	25.4	357	0.2	3	25.2	63.5	354	32	0.780	30
2	381.25	16.5	28.5	364	0.5	6	28.0	55.0	358	6	0.082	35
3	383.38	15.8	28.6	350	0.0	0	28.6	55.2	350	0	Imp.	50+
4	384.70	18.4	37.0	529	6.8	97	30.2	52.1	432	4	0.083	35
5	385.80	18.8	36.1	527	7.8	114	28.3	68.5	413	48	1.32	25
6	387.00	19.2	42.9	639	18.2	271	24.7	74.1	368	52	1.36	15
7	388.48	19.5	39.9	603	10.4	157	29.5	57.9	446	12	0.400	25
8	389.78	19.5	41.3	625	14.8	224	26.5	66.4	401	27	0.713	15
9	391.30	16.0	36.6	454	4.0	50	32.6	63.8	404	5	0.198	35
10	392.70	18.6	43.1	622	12.3	178	30.8	60.2	444	37	0.891	20
11	394.18	16.8	32.5	423	0.0	0	32.5	61.3	423	7	0.197	40
12	395.47	14.9	33.7	390	0.0	0	33.7	60.0	390	0	Imp.	50+
13	396.88	18.2	51.8	731	0.0	0	51.8	33.4	731	0	Imp.	50+

Notes: cc - cubic centimeter
*Volume of water recovered at the time of maximum oil recovery.
**Determined by passing water through sample which still contains residual oil.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Deep Rock Oil Corporation   Lease Engel   Well No. I-11

Depth Interval, Feet	380.30 - 386.05	386.15 - 393.20	383.00 - 393.20
Feet of Core Analyzed	3.75	6.60	8.65
Average Percent Porosity	17.92	18.47	18.38
Average Percent Original Oil Saturation	32.40	41.56	40.37
Average Percent Oil Recovery	4.19	13.29	11.87
Average Percent Residual Oil Saturation	28.21	28.27	28.50
Average Percent Residual Water Saturation	59.36	64.54	63.81
Average Percent Total Residual Fluid Saturation	87.57	92.81	92.31
Average Original Oil Content, Bbls./A. Ft.	452.	611.	591.
Average Oil Recovery, Bbls./A. Ft.	60.	197.	175.
Average Residual Oil Content, Bbls./A. Ft.	392.	414.	416.
Total Original Oil Content, Bbls./Acre	6,697.	4,031.	5,113.
Total Oil Recovery, Bbls./Acre	226.	1,301.	1,518.
Total Residual Oil Content, Bbls./Acre	1,471.	2,730.	3,595.
Average Effective Permeability, Millidarcys	0.539	0.794	0.774
Average Initial Fluid Production Pressure, p.s.i.	31.2	22.0	24.3

NOTE: Only those samples which recovered oil were used in calculating the above averages.

Oil Field Research Laboratories

RESULTS OF WATER DIFFERENTATION TESTS

TABLE VII

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1	380.44	11,100			
2	381.00	14,300			
3	383.12	14,100			
4	384.50	12,500			
5	385.62	12,400			
6	386.75	13,300			
7	388.23	15,200			
8	389.52	13,000			
9	391.04	15,100			
10	392.50	15,400			
11	393.93	13,800			
12	395.23	14,900			
13	396.63	15,700			

Note: ppm - parts per million

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SUMMARY OF WATER DIFFERENTATION TESTS

TABLE VIII

Company Deep Rock Oil Corporation Lease Engel Well No. I-11

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
380.30 - 386.05	13,237		
386.15 - 394.05	14,132		
394.30 - 396.75	15,318		
383.00 - 396.75	14,063		

Note: ppm - parts per million